

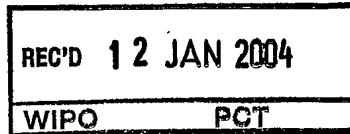


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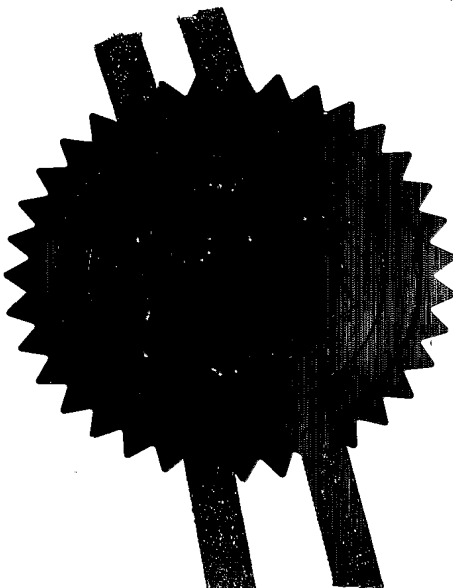


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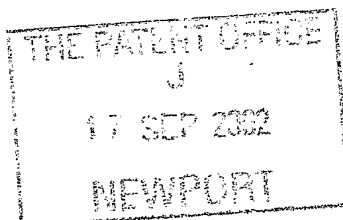
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1/77

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RFW/EB/B45320

2. Patent application number

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17 SEP 2002

3. Full name, address and postcode of the or of each applicant (underline all surnames)

GlaxoSmithKline Biologicals s.a.  
Rue de l'Institut 89, B-1330 Rixensart, , Belgium

Patents ADP number (*if you know it*)

Belgian

If the applicant is a corporate body, give the country/state of its incorporation

8101271001

4. Title of the invention

Novel Device

5. Name of your agent (*if you have one*)

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Country	Priority application number ( <i>if you know it</i> )	Date of filing ( <i>day / month / year</i> )
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Request for preliminary examination and search (*Patents Form 9/77*)

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11.

We request the grant of a patent on the basis of this application

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R F Walker

Date 16-Sep-02

12. Name and daytime telephone number of person to contact in the United Kingdom

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## Novel Device

This invention relates to a conveyor system, particularly to a conveyor system for conveying pharmaceutical vials, especially for conveying such vials past one or more processing station at which one or more operation such as filling or sealing may be performed. In particular the invention relates to holding means for securely holding articles onto such a conveyor.

Conveyor systems such as endless belts or chains are well known. In the pharmaceutical industry it is often necessary to solve the problems associated with conveying an article such as a vial through a sterile environment e.g. a downward laminar air flow. For this purpose a conveyor must comply with Good Manufacturing Practice ("GMP") and corresponding FDA requirements. These call for a conveyor system that minimises the possibility of contamination, can easily be cleaned, and can easily be swept by such a laminar flow. A particular problem associated with such a laminar flow over a conveyor in a poorly designed system is that sterile air, having flowed past an upstream part of the conveyor or a vial on the conveyor, may "rebound" from a downstream surface and carry contamination upstream. Such a conveyor system must also satisfy the general requirement of holding articles sufficiently securely to enable safe transport of the articles, convenient processing at the processing stations, and easy release when the operations are completed.

It is an object of this invention to provide a conveyor system that meets these requirements.

According to this invention a holding device suitable for holding an article on a conveyor system comprises;

a base having an upper part able to mate with a downward facing surface of an article,

and a grip part having a grip means able to mate with an upward facing surface of the article, the grip part being moveable relative to the base between upper and lower positions of the grip part, such that when the grip part is in its upper position there is a gap between the grip means and the upper part of the base into which gap at least part of the article may be placed, and when the grip part is in

the lower position the grip means bears on the article and the downward facing surface of the article mates with the upper part of the base so that the article is held between the grip means and the base.

Preferably the holding device is suitable for gripping an article which is a pharmaceutical vial, either empty e.g. for filling, or filled e.g. for sealing. Such a vial may itself be held directly by the holding device of the invention, but preferably the vial may be carried in a carrier, the held article comprising the combination of a vial and a carrier, and the holding device is arranged to grip the vial carrier.

A suitable carrier may have a socket aperture in which the lower part of the vial body may sit, preferably seated securely therein by friction and/or resilience. Vials generally have a cylindrical body with a flat, rounded or profiled bottom. For example a suitable carrier may comprise a plastics material ring around such a socket aperture, and the bottom of the vial may sit in the aperture of such a ring.

The downward facing surface may comprise the underside of such a vial, or the underside of a carrier, or the underside of a combination of vial and carrier. The upward facing surface may be the upper surface of a vial closure, the upper surface of the shoulder that is normally around the part where the neck of a vial meets the body of the vial, or preferably an upward facing surface of a carrier in which a vial is carried. For example if the carrier has a socket aperture the upward facing surface may comprise the upward facing rim of the aperture or an upward facing surface adjacent to the rim of the aperture. The advantage of carrying the vial in a carrier, particularly a carrier in which the lower part of the vial body sits, is that the holding device may hold the vial carrier adjacent to the base of the vial, thereby avoiding the positioning of any parts of the holding device near to the vial mouth or closure where a filling or sealing operation may be taking place. With the vial in an upright orientation this can reduce the risk of "rebound" of airflow from lower downstream parts toward upstream parts of the vial.

The upper part of the base may mate with any of the above mentioned downward facing surfaces of an article such as a vial, carrier or vial-carrier combination. For example the upper part of the base may be flat, but is preferably of an upwardly convex shape, e.g. domed or (frustro) conical, and the downward facing surface of the article, e.g. the vial, carrier or vial-carrier combination, may

be of a matching concave shape, such that the convex and concave surfaces mate. The mating of such convex and concave surfaces can help with positioning and stabilising an article such as a vial.

A preferred form of grip part comprises an up-down extending shaft having a grip means at the upper end of the shaft. A preferred grip means comprises a grip arm connected e.g. integrally formed at an end thereof to the upper end of the shaft, and extending in a direction transverse to the shaft up-down direction, preferably perpendicular to this direction, to an opposite end of the grip arm remote from the shaft. Such a grip arm can bear upon the article. Preferably the grip means comprises two such grip arms, between which the article may fit, with both arms extending in the transverse direction. Preferably two such grip arms extend in the transverse direction parallel to each other, such that in plan as viewed downwardly the two grip arms and their connection with the shaft define a general "U" shape such that the article or part thereof can fit securely into the bite of the "U". Suitably the connection of two such arms to the shaft is at the centre of the bend of the "U".

The grip part, especially when this comprises one or more grip arm, preferably also comprises a support for the article, lower down on the grip part, e.g. on the shaft, than the grip arm(s). Such a support can fit underneath the article and support it whilst the grip part is in its upper position. A preferred construction is a support arm toward the upper end of the shaft and that extends transverse to, preferably perpendicular to, the up-down direction of the shaft to a remote end of the support arm. A preferred form of such a support arm is provided by a shaft and support arm in the form of a "T", the shaft comprising the downward stem of the "T" and the horizontal bar of the "T" comprising the support arm. The one or more grip arm, e.g. two grip arms in a "U" plan, may be connected via such a support arm to the shaft.

Preferably the base includes a guide to support and guide the grip part in its upward and downward movement between upper and lower positions. Such a guide may comprise a channel, e.g. a tubular channel, extending in the up-down direction which can receive the shaft of an above-described grip part and within which the shaft is slideably moveable up and down.

Preferably the grip part is biased toward its lower position. This may be achieved by suitably weighting the grip part so that when mounted on the base part the weight of the grip part is sufficient to overcome any friction between the grip part and the guide. For example the shaft may have a weighted lower end. The grip  
5 part and base may include mutual locking means to allow the grip part to be releasably locked into its upper and/or lower position. The weight of the grip part may bear upon the article to provide a force such that the article is held between the grip means and the base.

The upper part of the base may have a receiving cavity for the support, and  
10 into which the support may be received when the grip part is in its lower position. For example such a receiving cavity may comprise a receiving slot to receive a support arm as described above. Suitably the up-down depth dimension of the receiving cavity is greater than the up-down thickness dimension of the support so that when the support is received in the receiving cavity with the grip part in its  
15 lower position the upper surface of the support is below the upper surface of the upper part of the base. This construction enables the grip part to grip the article between the grip part and the base, with the downward facing surface of the article resting on the base and not on the support.

In another aspect the invention comprises a conveyor system for the transport  
20 of articles, particularly vials, in a conveying direction, provided with one or more of the above-described holding devices.

Suitably the conveyor system of this invention comprises a plurality of the holding devices, i.e. a plurality of bases and their associated grip parts, arranged in a row across the conveying direction, suitably perpendicularly across this direction.  
25 In such a construction if the grip means comprises a grip arm, especially the above-mentioned "U" shaped arrangement of two grip arms, the arm, e.g. the limbs of the "U" and hence the open bite of the "U" should be aligned to point in the opposite direction to the conveying direction. In such a construction a support arm is also preferably aligned parallel to the conveying direction. These alignments can assist in  
30 loading and unloading articles onto and off the conveyor system by a loader means as described below.



Suitably the conveyor system of this invention also comprises a loader means adjacent to the conveyor and arranged to load an article into the holding device.

Such a loader means may be configured to carry an article into a position relative to the holding device when the grip means is in its upper position, such that the

5 downward facing surface of the article is above the upper part of the base and the upward facing surface of the article is below the grip means. When the article is in this position the grip part can move into its lower position to grip the article. In the case of a vial, whether or not held by a carrier, the loader means may comprise jaws able to close around and grip a vial. Alternatively and preferably the loader means  
10 may comprise a fork able to fit around the vial and having an upward facing surface upon which a downward facing surface of the vial can sit. Such a downward facing surface may for example be the underside of a vial closure overhanging the neck or body of the vial, or the underside of a flange around the vial mouth.

Suitably the loader means may carry the article in a direction parallel to the  
15 conveying direction. The loader means should be able to cause or allow an article carried thereby to move downwardly, so as to enable the grip part to carry an article downwardly, toward the lower position of the grip part, whilst the article is still held by the loader means.

The loader means should be able to release an article carried thereby when  
20 the holding device has securely gripped the article. The loader means should be capable of motion between a position where the loader means can collect an article to be carried to the conveyor, and a position where the article can be received from the loader means by the holding device.

Suitably the conveyor system of this invention also comprises an unloader  
25 means adjacent to the conveyor and arranged to unload articles from the holding devices, for example when one or more operation(s) upon the article(s) is/are completed. Such a unloader means may be configured to receive an article gripped by the holding means, after which the grip part may move into its upward position to release the article from the holding device. In the case of a vial the unloader  
30 means may comprise jaws able to close around and grip the vial. Alternatively and preferably the loader means may comprise a fork able to fit around a vial carried by the conveyor and having an upward facing surface upon which a downward facing

surface of the vial can sit. Such a downward facing surface may for example be the underside of a vial closure, or the underside of a flange around the vial mouth.

With such a construction, when the grip means comprises the above-mentioned "U" shaped arrangement of grip arms with the mouth of the "U" pointing opposite to the conveying direction, when the article is received by the unloader means the continued motion of the conveyor in the conveying direction can easily displace the article from the grip means by moving the article out of the bite of the "U" when the grip part is in the upper position. The unloader means should be capable of motion between a position where the loader means can collect an article from the holding device, and a position where the article can be transferred by the unloader means to a destination for the article. The unloader means may for example have substantially the same construction and operation as the loader means, but be configured to operate in an opposite manner to the loader means.

One or more operation may be performed on articles such as vials carried by the conveyor system of this invention by means of one or more processing station arranged adjacent to the conveyor. Preferably such a processing station is positioned above the conveyor, and may have operative parts which move downward to process the articles. Examples of operations suitable for vials include filling, closing, heat sealing etc. and other operations conventional to pharmaceutical vials. To maintain sterility of the operating environment of the articles a downward laminar flow of purified air may be directed over articles carried on the conveyor.

Parts of the conveyor system, i.e. the above described holding device and its components, should be made of materials suitable to comply with the requirements of GMP, for example stainless steel, and should be made to a design that minimises corners, crevices, cavities etc. in which might contamination might accumulate and which might disrupt a downward laminar flow of purified air around the conveyor system, such a flow being a commonly used means of ensuring sterility.

The invention will now be described by way of example only with reference to the following drawings.

Fig. 1 shows a perspective view of a grip part.

Fig. 2 shows a perspective view of a base.

Fig. 3 shows a sectional view of a grip part engaged with a base.

Fig. 4 shows the operation of the holding device to hold a vial.

Figs. 5 and 6 show a conveyor system incorporating the holding device of Figs. 1-4.

The following parts are identified in Figs. 1-6.

- 5 10 holding device
- 20 base
- 21 mounting plate
- 22 rib
- 23 upper part
- 10 24 flange
- 25 central convex portion
- 36 enlarged lower end of the shaft
- 26 tubular guide
- 27 upper end of guide
- 15 28 receiving cavity
- 30 grip part
- 31 shaft
- 32 grip means
- 33 grip arms
- 20 34 linking bend of the "U"
- 35 support arm
- 35A,35B limbs
- 40 pharmaceutical vial
- 41 closure
- 25 42 neck of vial
- 43 body of vial
- 44 bottom of vial
- 45 concave underside of vial
- 50 carrier
- 30 51 central aperture
- 60 conveyor system
- 61 continuous chains of links

- 61A upper part of conveyor
- 61B lower part of conveyor
- 62 ends of links
- 63 guide wheel
- 5 70 loader means
- 71 fork jaws
- 701 retracted position
- 702 forward position
- 80 processing station
- 10 81 processing station
- 90 unloader means
- 91 jaws of unloader means
- 100 laminar airflow

Referring to Figs 1 to 4, a holding device 10 suitable for the conveyor system of this invention is shown. The holding device 10 comprises a base 20, and a grip part 30 described in more detail below.

The base 20, made integrally of stainless steel, comprises a mounting plate 21, suitable to engage with a conveyor system (not shown). The plate 21 is shown generalised and it will be understood that various types of known mounting will suit various known types of conveyor system. The plate 21 integrally extends upwardly as a rib 22, strengthening and stabilising the base 20.

The base 20 has an upper part 23, comprising a generally horizontally extending flange 24 with a generally flat upper surface, with a central convex portion 25 of an overall frustro-conical shape.

The grip part 30 is also integrally made of stainless steel and comprises an up-down extending cylindrical shaft 31, having at its upper end a grip means 32 generally. Grip means 32 comprises two grip arms 33 extending parallel to each other in a direction perpendicular to the up-down direction on opposite sides of the up-down axis direction of the shaft 31, so that in plan looking downwards the arms 33 are seen to be of a generally "U" shape linked at 34 being the bend of the "U".

The grip means 32 also includes a support arm 35, integrally connected to the upper end of the shaft 31, extending perpendicular to the shaft 31 and forming

generally a "T" shape with the shaft 31, with the two limbs 35A, 35B of the "T" extending in a direction perpendicular to the up-down direction of the shaft 31, and parallel to the arms 33. In the construction shown the support arm 35 is lower down than the arms 33, the link 34 descending to be linked to the extremity of the limb  
5 35A of arm 35 remote from shaft 31 to set a vertical gap between arms 33 and 35. Upper end 31A of the shaft 31 is widened into a wider cylindrical diameter.

The extremities of arms 33 and 35B are roundly profiled to assist the horizontal introduction of an article into the vertical gap between them.

The lower end of the shaft 31 is enlarged at 36, to weight the grip part 30.

10 Figs 3A, 3B and 3C are vertical sections through the base 20 and grip part 30 cut along perpendicular planes, Fig. 3A showing the base 20 and grip part 30 separately, Fig. 3A showing the grip part 30 in its upper position, Fig. 3B in its lower position. As seen in Figs. 3A-C, the base 20 has an upwardly extending tubular guide 26 formed integrally with mounting plate 21 and rib 22, having upper  
15 and lower open ends, the upper end 27 being visible in Fig. 1. The shaft 31 of grip part 31 fits in a smooth sliding fit within guide 26, the enlarged lower end 36 of shaft 31 being removable, e.g. by a screw thread, to allow the shaft 31 to be inserted therein, and to be retained by the enlargement 36 when the enlargement 36 is re-fitted. The grip part 30 is slideably moveable relative to the base 20 between an  
20 upper position shown in Fig 3A, and a lower position as shown in Fig. 3B of the grip part 30.

When the grip part 30 is in its upper position as in Fig 3A, there is a vertical gap between the arms 33 and the upper part 24, 25 of the base 20. The grip part 30 may be held or supported in this position by ancillary means (not shown) such as an  
25 abutment part or ramp surface adjacent the lower end 36 of the shaft, and which the lower part 36 may contact e.g. during horizontal movement of the assembly 20 30 during operation of a conveyor system of which the holding device 20, 30 comprises a part.

The upper part 25 of the base 20 has a receiving cavity 28 in the form of a  
30 receiving slot extending across the flange 24 and the convex part 25, with its length direction perpendicular to the up-down axis. This receiving cavity 28 receives the support arm 35 when the grip part 30 is in its lower position, as can be seen in Fig.

3B. The shape of the receiving cavity 29 corresponds with that of the support arm 35, having a widened part to receive the cylindrically widened part 31A of the upper end of shaft 31. The depth of the receiving cavity 28 is greater than the thickness dimension of the support arm 35 so that when the support arm 35 is received in the  
 5 cavity 28 the upper surface 35A of the support arm 35 is below the upper surface of the part 24 of the base 30, as seen in Fig. 3B.

In its upper position as seen in Fig. 3A the support arm 35 is received in an raised position in receiving cavity 28 i.e. occupying that part of the cavity 28 which cuts through the conical upper part 25, with its upper surface level with the top of  
 10 the frustro-conical part 25. In its lower position as seen in Fig. 3B the support arm 35 is a lowered position with its upper surface below the level of the upper surface of flange 24.

Figs. 4A, 4B and 4B shows more clearly the operation of the holding device 20, 30 in holding a vial 40.

15 Figs. 4A-C shows a typical pharmaceutical vial 40, having a closure 41, a neck 42, a cylindrical body 43, and a profiled bottom 44. Figs. 4A-C also show a carrier 50 for of the vial 40, comprising a ring of plastics material surrounding a central aperture in which the bottom 44 of the vial 40 sits and is securely held by a friction fit. The bottom 44 of the vial 40 is profiled externally in a downward facing  
 20 concave frustro-conical shape 45. The flat surface 24 and convex part 25 are shaped to mate with the downward facing correspondingly shaped underside surface 45 of the vial and the carrier 50.

The carrier 50, with a vial 40 therein may be moved horizontally into the position shown in Fig. 4A, with the grip part 30 in its upper position, corresponding  
 25 to Fig. 3B, so that the vial 40 fits between the arms 33, the carrier 50 fits into the vertical gap between arms 33 and 35, lower rim 53 of the carrier 50 rests on the upper surface of the support arm 35 and the carrier 50 fits into the gap between arms 33 and the upper part 24, 25 of base 20. In this position the downward facing underside 45 of the vial 40 and of carrier 50 is above the part 24, 25 of the base 20.  
 30 The above mentioned rounded ramped profiling of the extremities of the arms 33 and 35B facilitates the smooth horizontal movement of the carrier 50 between arms 33 and 35.

The grip part 30 is now moved into its lower position as seen in Fig. 4B corresponding to Fig 3C. This may be achieved simply by gravity, e.g. by removing any means (not shown) by which the grip part 30 is maintained in its upper position, so that the weight of the grip part 30 biases and pulls the part 30 downward.

5 Alternatively the grip part 30 may be positively urged downwards by a mechanism (not shown).

When the grip part 30 is in the lower position as shown in Fig 4B with the vial 40 and carrier 50 in place, the arms 33 bear on the upper surface of the carrier 50, and the underside 45 of the vial 40 and carrier 50 mate with the upper part 25 of  
10 the base 20 so that the carrier 50 is held between the arms 33 and the upper part 25 of the base 20. The holding of the carrier 50 between the arms 33 and the upper part 25 of the base 20 in this way is shown in Fig.4B and 4C. The underside of the base 50 and the bottom 45 of the vial 40 mate securely with the upper parts 24 and 25 of the base 20.

15 When the support arm 35 is received in the cavity 28 the upper surface 35A of the support arm 35 is below the upper surface of the part 24 of the base 30, as seen in Figs 4B and 4C. This construction enables the grip part 30 to grip the carrier 50 between the grip arms 33 and the base 20, with the underside of the carrier 50 resting on the upper surface of the flange 24, the underside of the carrier 50 no  
20 longer resting on the arm 33.

Referring to Fig. 5 part of a conveyor system 60 is shown in a perspective view, and the overall arrangement of the conveyor system is shown generally in a schematic side view in Fig. 6. The view in Fig. 5 is generally from above, with the conveying direction indicated by the arrow. The conveyor system 60 is of generally  
25 conventional construction, and comprises a pair (only one is part shown in Fig. 5) of continuous chains of links 61, pivotally connected together at ends 62 of the links 61, the chains being arranged to move in parallel. The chain of links 61 moves such that an upper section 61A of each chain of links 61 moves in the conveying direction shown by the arrow, whilst the opposite lower section 61B of each chain of links 61  
30 moves in the opposite return direction. At each end the chain of links 61 is supported in a conventional manner by a guide wheel 63 (not shown in Fig. 5), mounted for rotation about a rotation axis perpendicular to the conveying direction.

One or more guide wheel 62 may be motor driven to thereby drive the conveyor system in the directions referred to, and the chain of links 61 may be supported by other support means, e.g. support wheels etc. (not shown) in a generally conventional manner.

5 Plural holding devices 20,30 are mounted on the conveyor 60 by means of their mounting plates 21, by a conventional mounting (not shown). Each holding device 20,30 is mounted so that its up-down direction extends perpendicular to the conveying direction of the upper part of the chain 60. The plural holding devices 20,30 are arranged in plural rows perpendicularly across the conveying direction.

10 The grip means 33 of the grip part of each of the holding devices 20,30 comprises a pair of grip arms forming a "U" shaped arrangement as described above, and as is seen in Fig. 5 the limbs 33 of each "U" and hence the open bite of the "U" point in the opposite direction to the conveying direction. Also the support arm 35 of each grip part 30, and hence the receiving slot 28 of each base 20, is  
15 aligned parallel to the conveying direction.

The conveyor system 60 also comprises a loader means 70 (generally) adjacent to the conveyor 60 and arranged to load articles, being vials 40 mounted in carriers 50, into the holding device 20,30.

The loader means 70 comprises plural fork jaws 71 each able to fit around  
20 and grip a vial 40. The bite of each set of fork jaws 71 faces in the conveying direction. In Fig. 5 one such loader means 701 is shown in a retracted position and carrying a vial 40 gripped by the fork 71. Each loader means is reciprocally moveable in and opposite to the conveying direction (either individually or together with all the loader means 70), and the loader means 702 is shown in Fig. 5 in a  
25 forward position moved in the conveying direction relative to the retracted position 701. The conveyor means 60 is constructed so that as the holding devices 20,20 mounted thereon adopt a vertical configuration the grip part 30 is moved (e.g. by contact with a ramp surface (not shown)) into its upper position. The loader means 70 and conveyor 60 are configured so that immediately the holding devices 20, 30  
30 have adopted this vertical position the loader means carries the vial 40 in the conveying direction into a position relative to the holding devices 20, 30 such that the underside of the vial 40 and carrier 50 is resting on the support arm 35 and is



above the upper part of the base 20, the vial 40 is between the arms 33 i.e. in the bite of the "U", and the upper surface of the carrier 50 is below the grip arms 33. The movement of the loader means 70 in the conveying direction between the retracted and forward positions 701,702 is arranged to be such that there is zero  
5 relative velocity between the means 70 and the holding device 20,30 when the vial 40 and carrier 50 are in this position.

The grip part 30 can now move into its lower position to grip the article as described above.

The grip of the fork jaws 71 is sufficiently light that as the grip part 30  
10 moves downward to grip the vial carrier 50 the vial 40 can move downward in the grip of the fork jaws 71. Alternatively the loader means 70 itself may be arranged to move downwardly whilst holding the vial 40, and/or to release the vial in another manner e.g. by a positive release of the grip. The holding device 20,30 and the loader means 70 are configured that the vial 40 is securely held by the holding  
15 device 20,30 by the time the loader means 70 reaches the forward limit of its movement, such that the relative motion in the conveying direction between the holding device 20,30 and the loader means 70 carries the vial 40 and carrier 50 out of the grip of the fork jaws 71.

The loader means 70 can then return to its retracted position 701 and can be  
20 re-loaded with another vial 40 and carrier 50. Whilst this is happening the next row of empty holding devices 20,30 are moving upward toward their vertical orientation to receive this new vial and carrier 50, and the movement of the loader means 70 into its retracted position 701 moves the loader means 70 out of the path of the next row 20A,30A of holding devices, rising as the wheel 63 rotates. Suitable means,  
25 e.g. a robot handling means, by which the loader means can be loaded with a new vial 40 and carrier 50 will be apparent to those skilled in the art. For example plural vials 40 and carriers 50 can be provided in a row transverse to the conveying direction, and corresponding to the spacing of the plural fork jaws 71 of the loading means 70, and can be moved into the path of the loading means 70 as it moves in  
30 the conveying direction so that each vial 40 intercepts the path of a fork 71 and is caught by the fork 71.

In the course of their movement in the conveying direction the vials 40 are subjected to one or more process, such as filling, closing, sealing etc. applied by one or more processing stations 80, 81. Particular processes for which the vials 4 are suitable, using the conveyor device of this invention, are a filling process  
5 applied at processing station 80 in which the vials 40 are filled by passing a filling needle (not shown) through their puncturable closure 41 and injecting them with a liquid medicament, and then heat sealing the residual puncture hole at a sealing station 81 using a focused laser beam. Suitable vials for such a sequence of processes are for example disclosed in GB 0219152 (16/08/2002) and US  
10 2002/0023409A1, the latter also providing detail of such processes, and the content of which are included herein by reference.

After the processes to be applied to the vials 40 have been completed, the vials may be unloaded from the conveyor system by unloader means 90 positioned at a downstream end of the conveyor system. The unloader means may be a  
15 mechanism essentially a similar but opposite construction to the loader means 70. That is, vials 40 and carriers 50 may be carried by holding means 20,30, and the unloader means 90 may have fork jaws 91 similar to those 71 but with their bite facing opposite to the conveying direction positioned to receive vials carried by the holding means 20,30 whilst the vials 40 and carriers 40 are securely held by the  
20 holding means 20,30. The downstream end of the conveyor 60 may be constructed so that when vials 40 are caught in this way by such fork jaws 91 of the unloading means 90 and securely held thereby, the grip part 30 is moved into its upper position to release the vial 40 and carrier 50. The vials 40 and carriers 50 may then be carried by the jaws 91 of the unloader means 90 away from the vicinity of the  
25 conveyor 60 by a horizontal movement of the unloader means 90. Suitably the vials 40 are received by the unloader means 90 and removed from the holding means 20,30 whilst the vials 40 are still moving horizontally and before the holding means 20,30 have begun their descent at the downstream end of the conveyor 60.

Thereafter vials held by the unloading means 90 may be delivered to a  
30 suitable receiving means, e.g. delivered to another conveyor (not shown) or to defined locations etc.

To maintain sterility of the vials 40 during their conveying along the conveyor 60 and the performance of the processes at stations 80, 81 a laminar flow 100 of purified air may be directed downwardly. It is seen in Fig. 6 that the vials 40 are held by their carriers 50 such that the vials are held adjacent their bottom 44 so  
5 that there is reduced risk of upward rebound of the airflow toward the upper part or closure 41 of the vials 40.

## Claims.

1. A holding device suitable for holding an article on a conveyor system comprises;  
5 a base having an upper part able to mate with a downward facing surface of an article,  
and a grip part having a grip means able to mate with an upward facing surface of the article, the grip part being moveable relative to the base between upper and lower positions of the grip part, such that when the grip part is in its  
10 upper position there is a gap between the grip means and the upper part of the base into which gap at least part of the article may be placed, and when the grip part is in the lower position the grip means bears on the article and the downward facing surface of the article mates with the upper part of the base so that the article is held between the grip means and the base.  
15
2. A holding device according to claim 1 adapted for gripping an article which is a pharmaceutical vial.
3. A holding device according to claim 2 wherein the vial is carried in a  
20 carrier, the held article comprising the combination of a vial and a carrier, and the holding device is arranged to grip the vial carrier.
4. A holding device according to claim 1, 2 or 3 wherein the grip part comprises an up-down extending shaft having a grip means at the upper end of the  
25 shaft.
5. A holding device according to claim 4 wherein the grip means comprises a grip arm connected at an end thereof to the upper end of the shaft, and extending in a direction transverse to the shaft up-down direction to an opposite end of the grip  
30 arm remote from the shaft, and which can bear upon the article.

6. A holding device according to claim 4 or 5 wherein the grip means comprises two said grip arms, between which the article may fit, with both arms extending in the transverse direction.

5 7. A holding device according to claim 6 wherein the two said grip arms extend in the transverse direction parallel to each other, such that in plan as viewed downwardly the two grip arms and their connection with the shaft define a general "U" shape such that the article or part thereof can fit securely into the bite of the "U".

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8. A holding device according to any one of claims 5, 6 or 7 wherein the grip part also comprises a support for the article, lower down on the grip part, than the grip arm(s) and which can fit underneath the article and support it whilst the grip part is in its upper position.

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9. A holding device according to claim 8 wherein the support comprises a support arm toward the upper end of the shaft and that extends transverse to the up-down direction of the shaft to a remote end of the support arm.

20 10. A holding device according to claim 9 wherein the support arm is provided by a shaft and support arm in the form of a "T", the shaft comprising the downward stem of the "T" and the horizontal bar of the "T" comprising the support arm.

11. A holding device according to any one of the preceding claims wherein the  
25 base includes a guide to support and guide the grip part in its upward and downward movement between upper and lower positions.

12. A holding device according to claim 11 wherein the grip part comprises an up-down extending shaft having a grip means at the upper end of the shaft and  
30 wherein the guide comprises a channel extending in the up-down direction which can receive the shaft and within which the shaft is slideably moveable up and down.

13. A holding device according to any one of the preceding claims wherein the grip part is biased toward its lower position.
14. A holding device according to any one of claims 8 to 13 wherein the upper part of the base has a receiving cavity for the support, and into which the support may be received when the grip part is in its lower position.
15. A holding device according to claim 14 wherein the up-down depth dimension of the receiving cavity is greater than the up-down thickness dimension of the support so that when the support is received in the receiving cavity with the grip part in its lower position the upper surface of the support is below the upper surface of the upper part of the base.
16. A conveyor system for the transport of articles in a conveying direction, provided with one or more holding device as claimed in any one of claims 1 to 15.
17. A conveyor system according to claim 16 which comprises a plurality of the said holding devices arranged in a row across the conveying direction.
18. A conveyor system according to claim 16 or 17 wherein the grip means comprises a grip arm aligned to point in the opposite direction to the conveying direction.
19. A conveyor system according to claim 18 wherein the grip means comprises a "U" shaped arrangement of two grip arms, the limbs of the "U" and hence the open bite of the "U" being aligned to point in the opposite direction to the conveying direction.
20. A conveyor system according to claim 18 or 19 having a support arm aligned parallel to the conveying direction.

21. A conveyor system according to any one of claims 16 to 20 provided with a loader means adjacent to the conveyor and arranged to load an article into the holding device when the grip means is in its upper position, such that the downward facing surface of the article is above the upper part of the base and the upward facing surface of the article is below the grip means.
22. A conveyor system according to claim 21 wherein the loader means is configured to carry the article in a direction parallel to the conveying direction.
23. A conveyor system according to claim 21 or 22 wherein the loader is configured to cause or allow an article carried thereby to move downwardly, so as to enable the grip part to carry an article downwardly, toward the lower position of the grip part, whilst the article is still held by the loader means.
24. A conveyor system according to claim 21, 22 or 23 configured to release an article carried thereby when the holding device has securely gripped the article.
25. A conveyor system according to any one of claims 21 to 24 wherein the loader means is capable of motion between a position where the loader means can collect an article to be carried to the conveyor, and a position where the article can be received from the loader means by the holding device.
26. A conveyor system according to any one of claims 16 to 25 provided with an unloader means adjacent to the conveyor and arranged to unload articles from the holding devices.
27. A conveyor system according to claim 26 wherein the unloader means is configured to receive an article gripped by the holding means, and the holding means is configured so that thereafter the grip part moves into its upward position to release the article from the holding device.

28. A conveyor system according to any one of claims 16 to 27 provided with one or more processing station arranged adjacent to the conveyor for performing one or more operation upon an article carried by the conveyor.



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Fig. 1

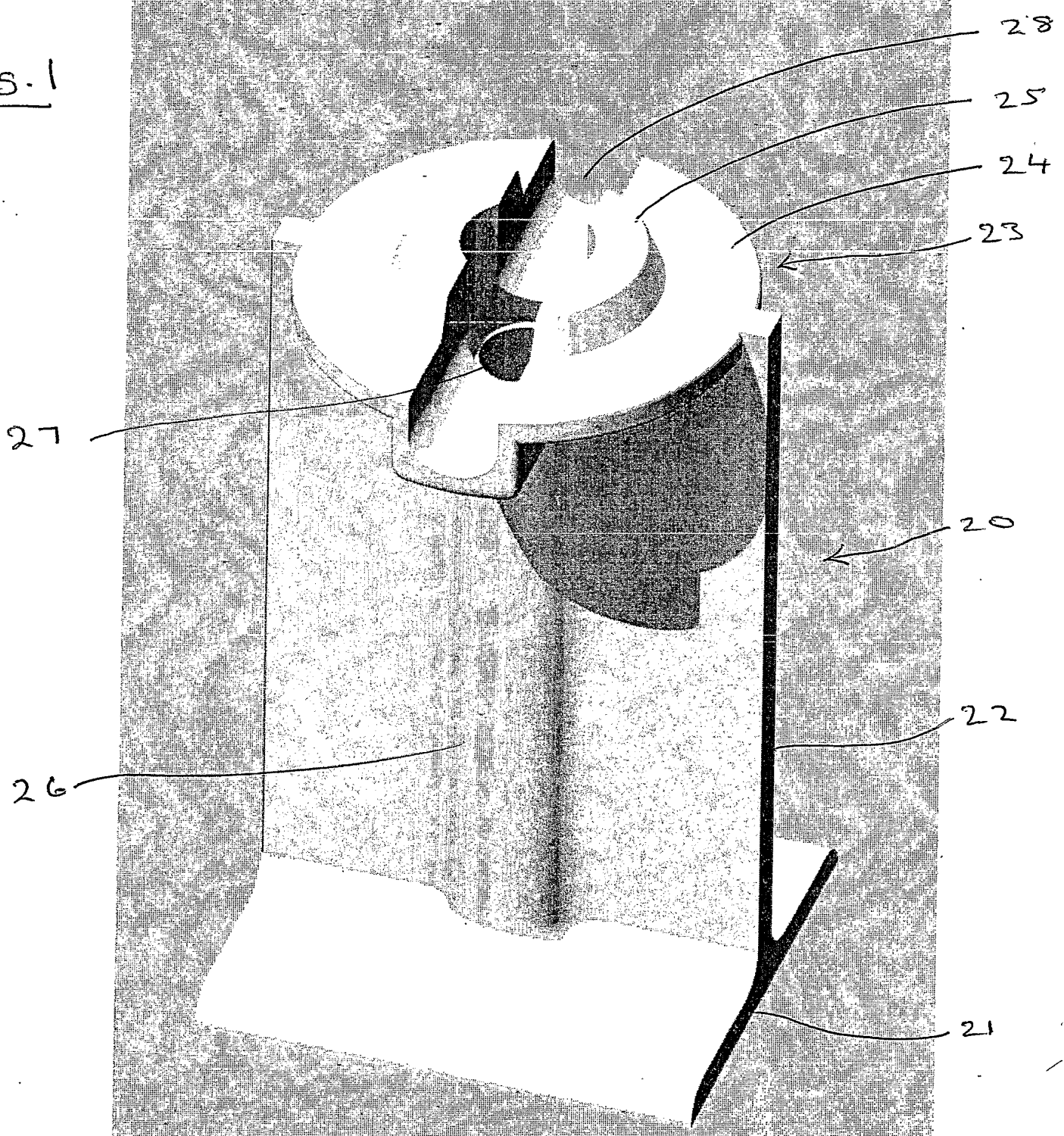
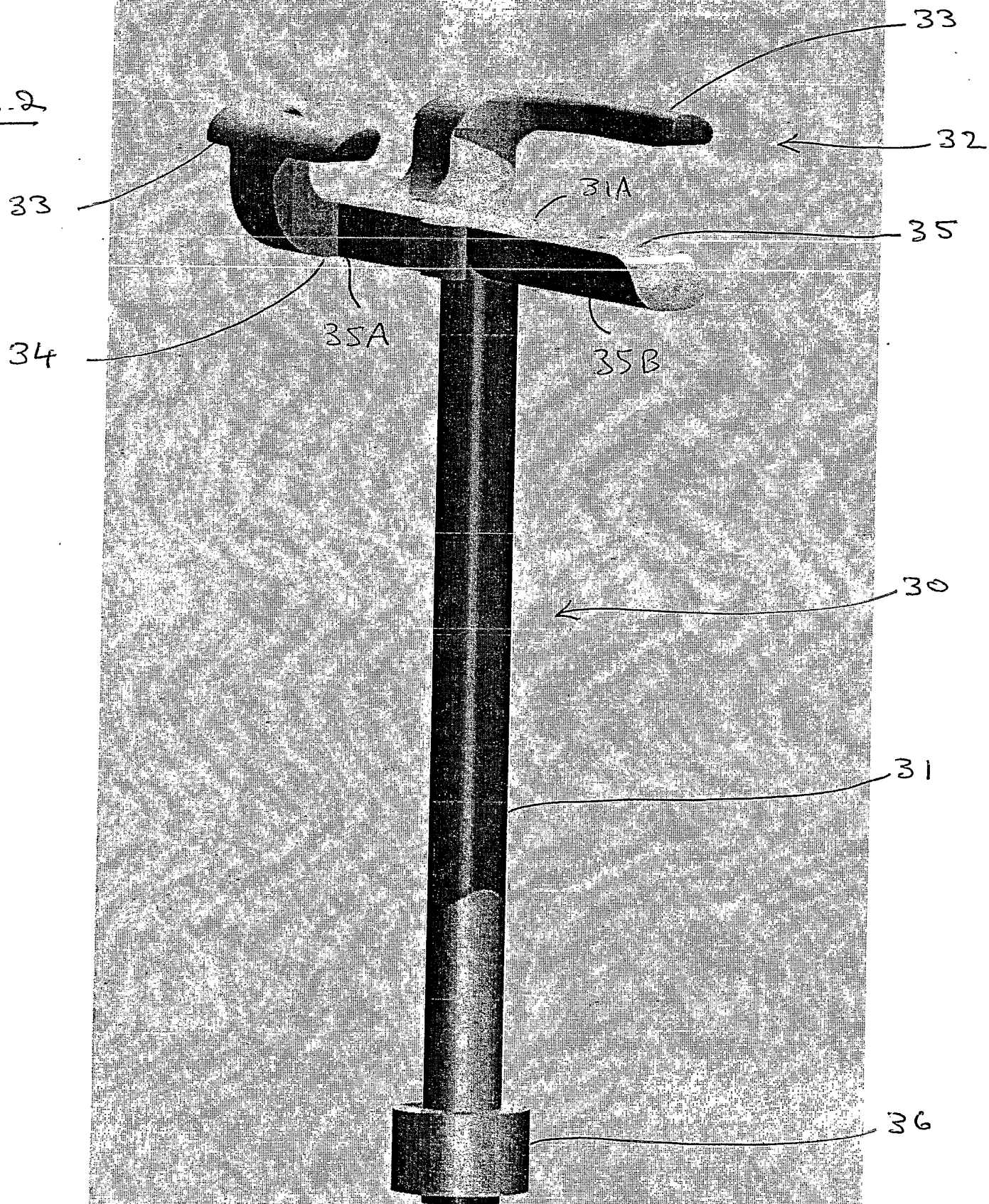
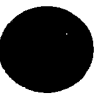




Fig. 2



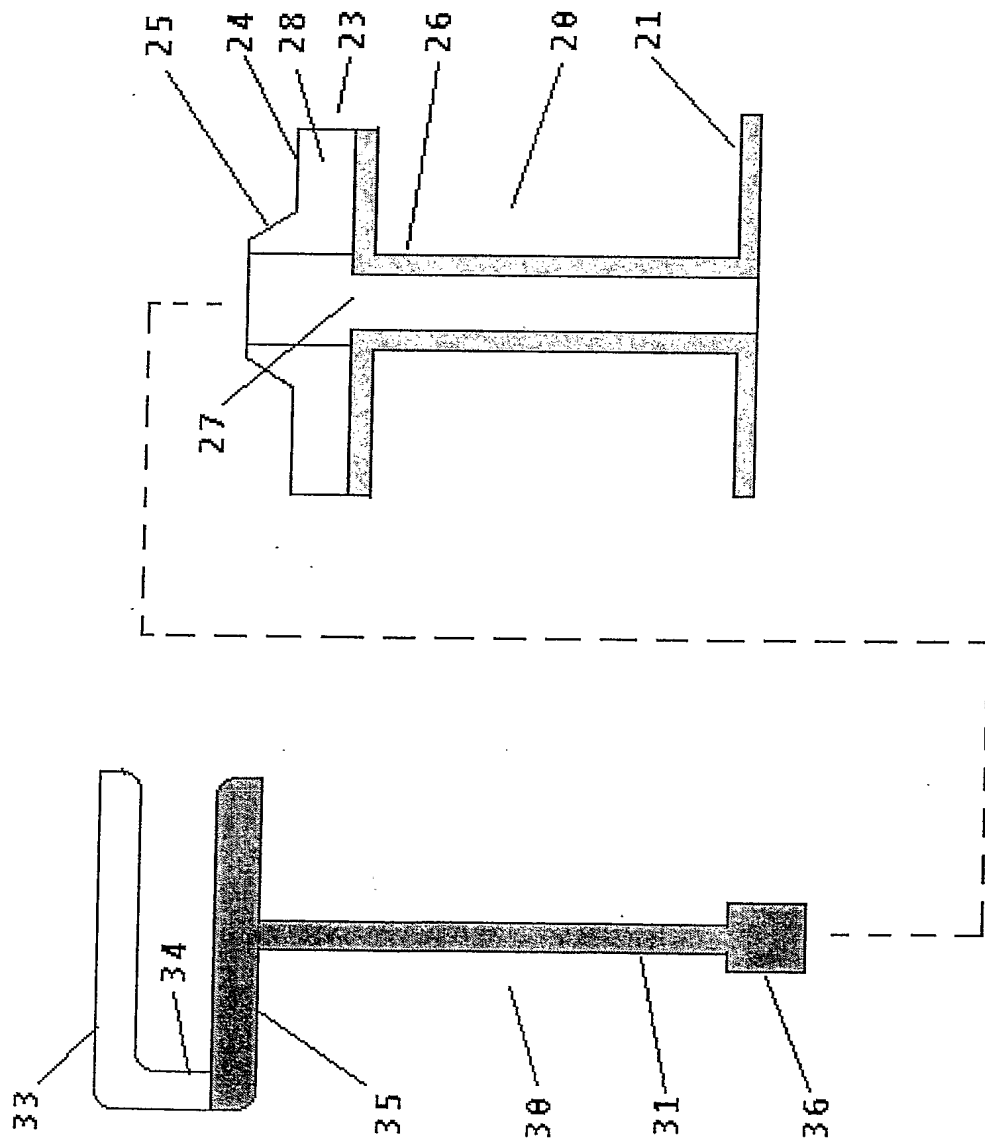


Fig. 3A



Fig. 3

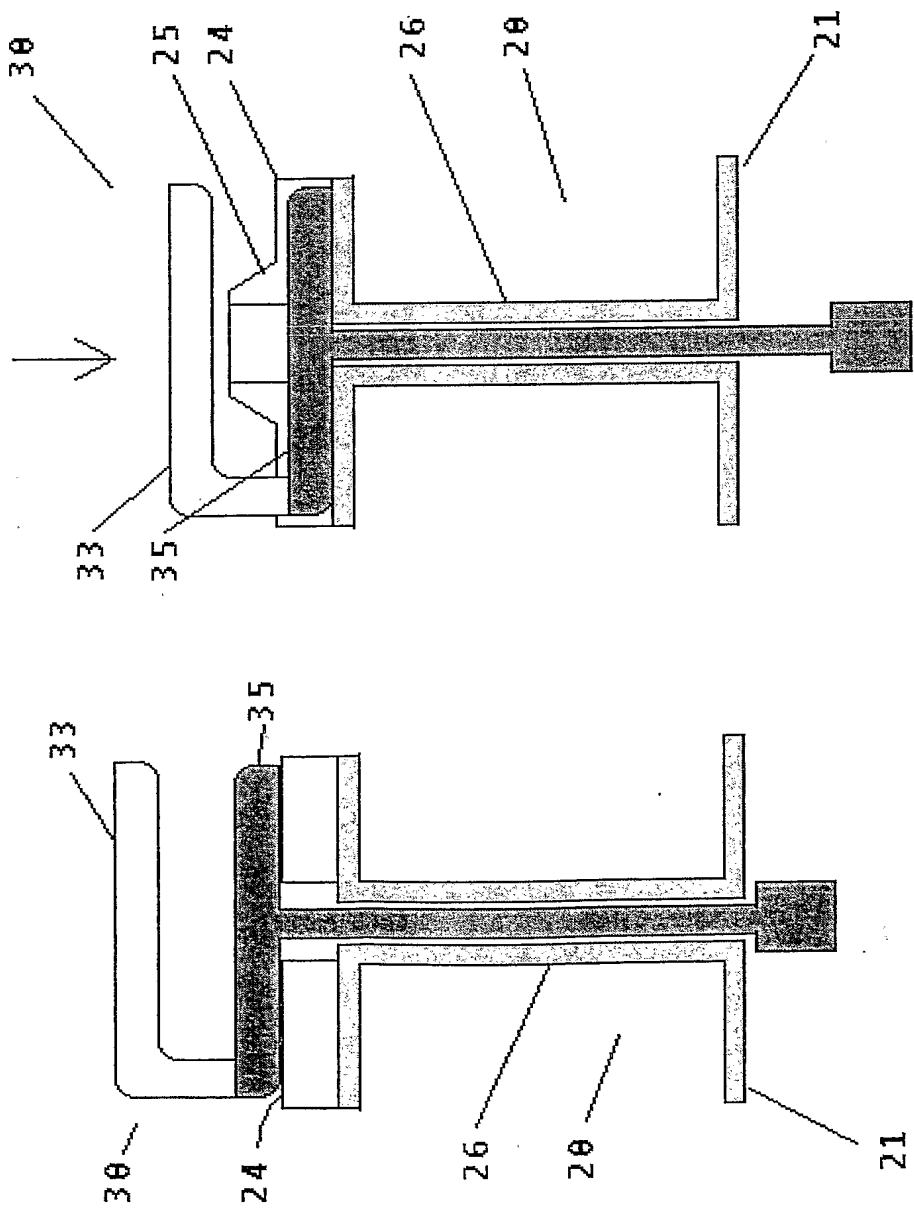


Fig. 3C

Fig. 3B





Fig. 4

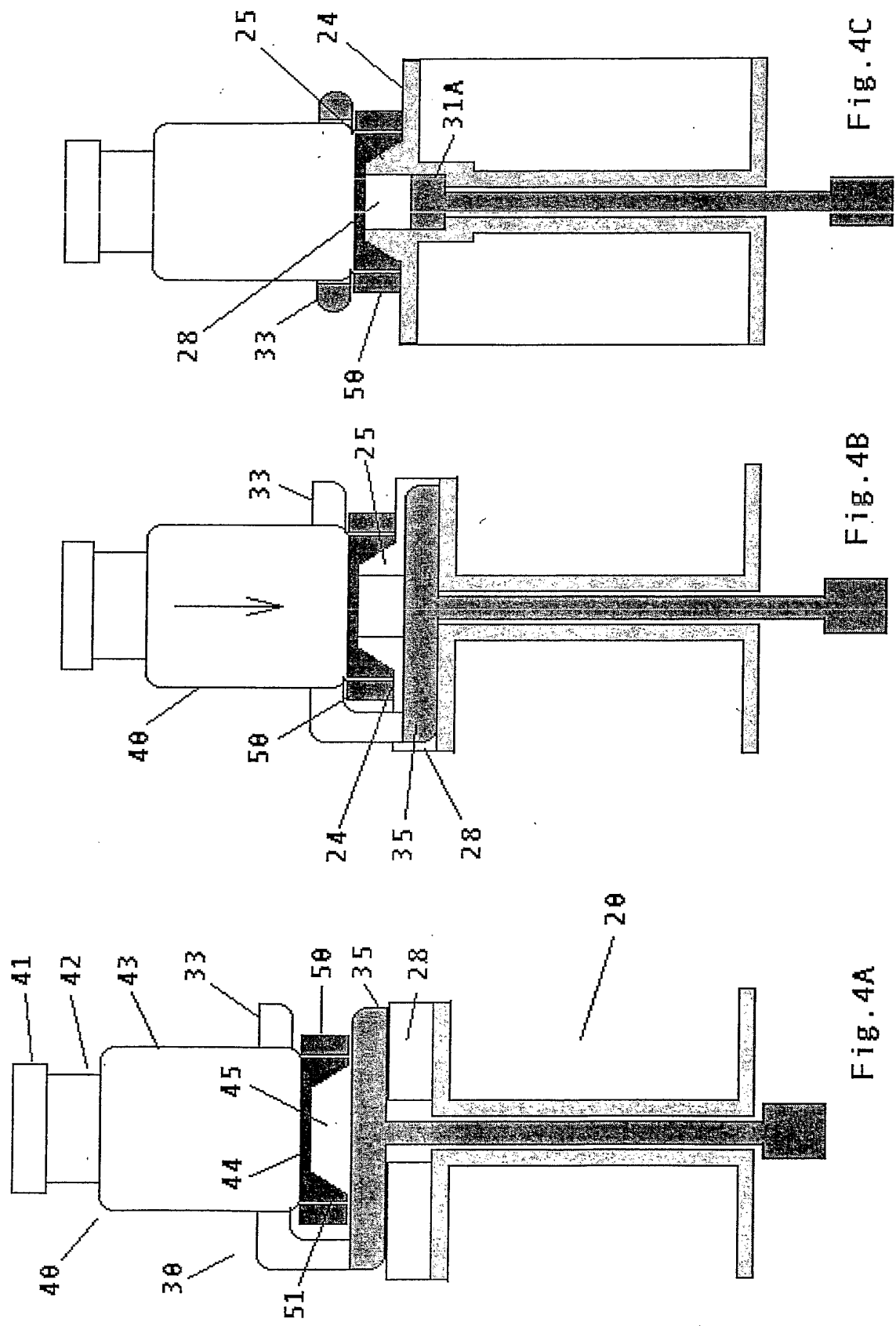
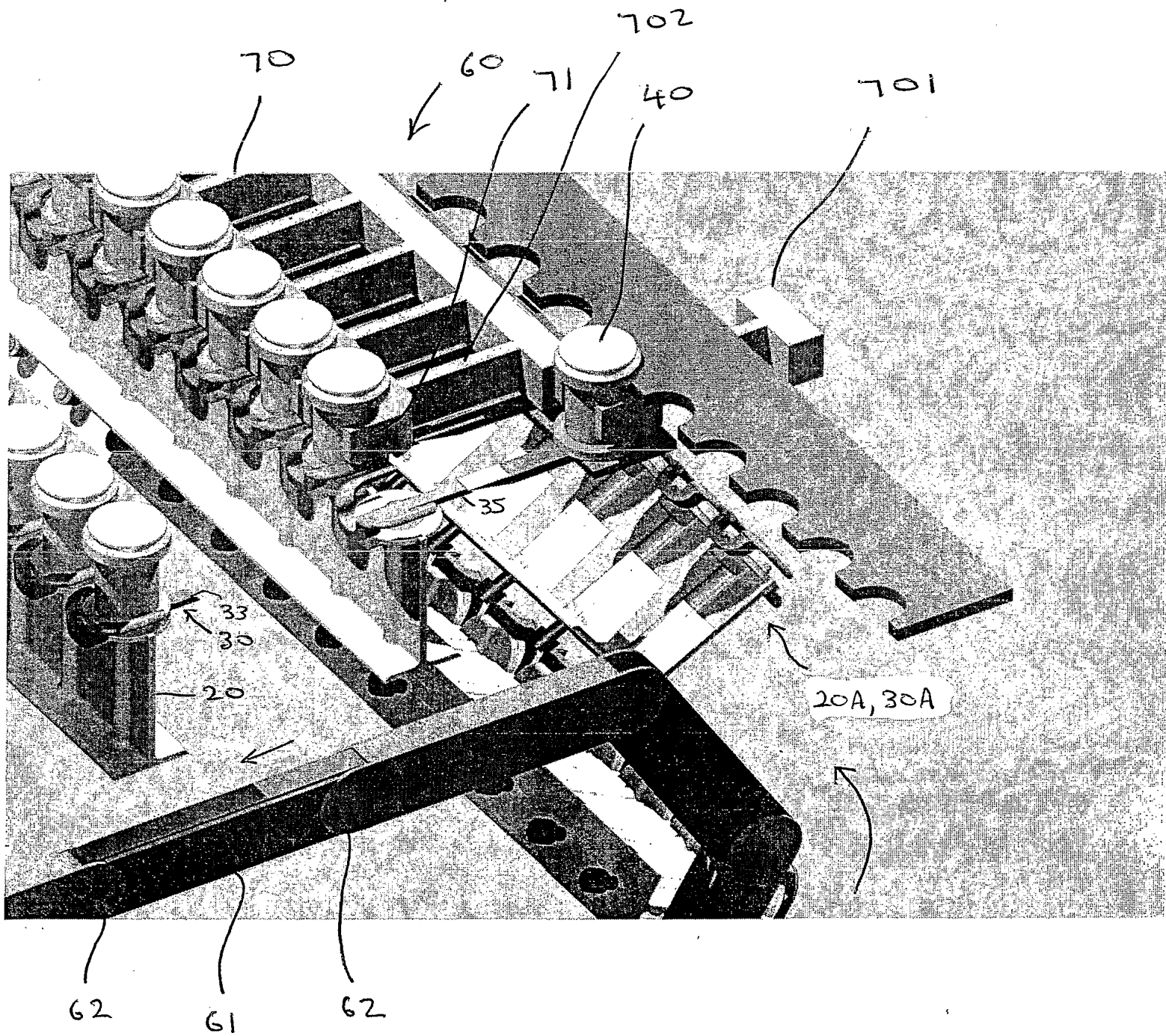




FIG. 5



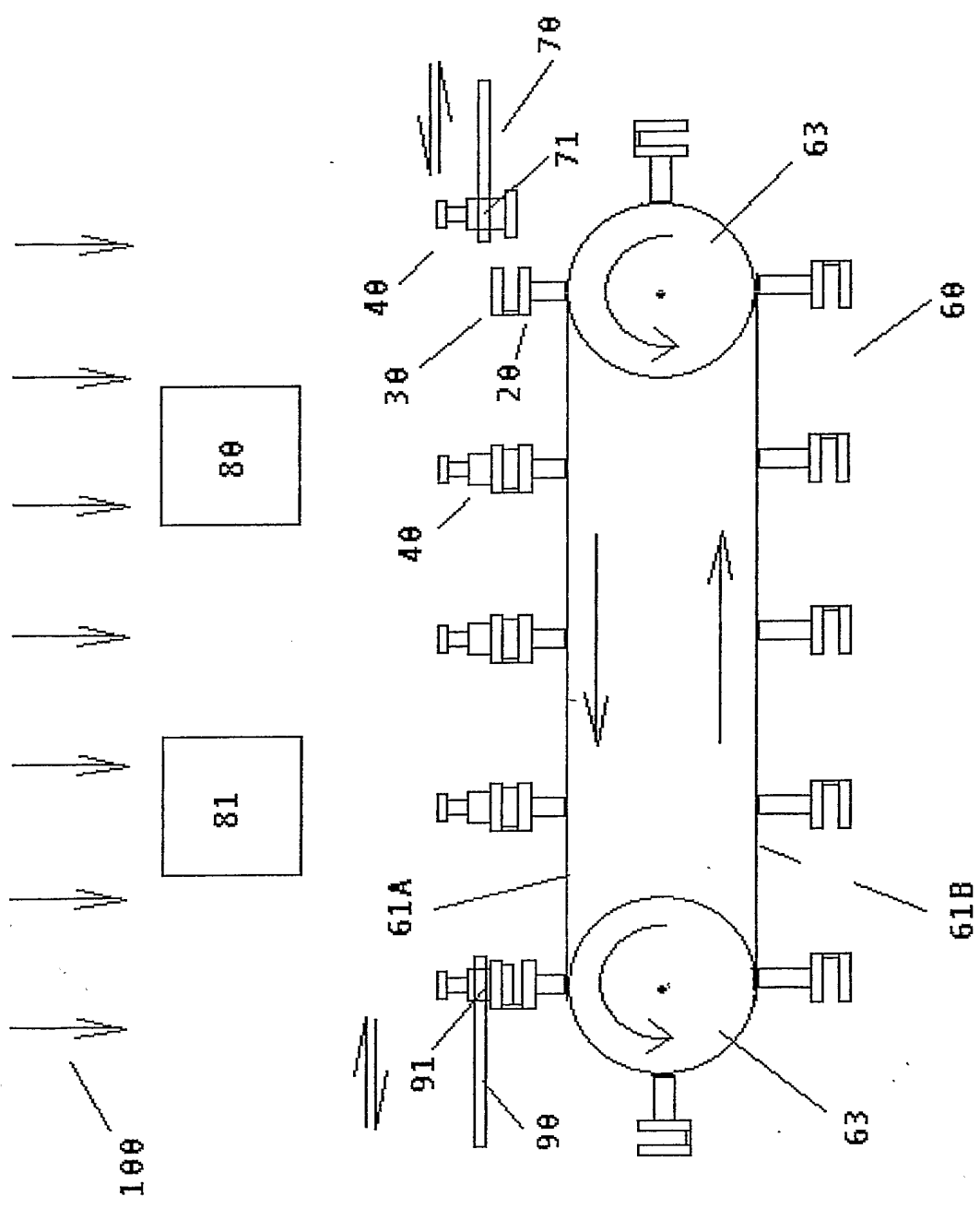


Fig. 6



PCT Application  
**EP0310349**

